

REMARKS

Claims 3, 8, 11-13, 20 and 21 have been amended and claims 4, 5, 7, 9, 10, 14-19, 21, 25, 28, 32-35 and 38-40 have been canceled. Claims 1-3, 6, 8, 11-13, 20, 22-24, 26, 27, 29-31, 36, 37 and 41 remain in the application. The Office Action states that claim 41 has been withdrawn from consideration, however, claim 41 is stated (p. 3, item 5) in the Office Action dated Sept. 23, 1999 to be in Group F, i.e., to be in the group of claims elected for prosecution. Reconsideration of the application in view of the amendments and the remarks to follow is requested.

Claims 1 and 2 stand rejected under 35 U.S.C. §102(a) as being anticipated by Kasulke et al., "Solder Ball Bumper (SBB) - A Flexible Equipment For FC, CSP, BGA and Printed Circuit Boards". Claims 1, 3, 11-13, 27, 29 and 31 stand rejected under 35 U.S.C. §102(b) as being anticipated by Desai et al., U.S. Patent No. 5,479,703. Claims 2, 6, 8, 20, 22-24, 26, 30, 36 and 37, and presumably 41, stand rejected under 35 U.S.C. §103(a) as being unpatentable over Desai et al. in view of Kasulke et al.

Claim 1 recites "A method of bonding balls of solder to bond pads on a substrate comprising: contemporaneously retaining at least two balls of solder over different respective bond pads on a substrate in the absence of flux; and with the balls so retained, exposing the balls to bonding conditions effective to bond the balls with their associated bond

1 pads." In contrast, Kasulke et al. teach a method of applying and then
2 melting one ball of solder at a time.

3 Solder balls that are "contemporaneously retained" on a substrate
4 according to the teachings of Kasulke et al. have been melted and are
5 metallurgically joined with features formed on the substrate. As such,
6 there is no need for joining the balls to the substrate by "exposing the
7 balls to bonding conditions effective to bond the balls with their
8 associated bond pads" after the balls taught by Kasulke et al. are
9 retained on the substrate as recited in claim 1.

10 The teachings of Kasulke et al. fail to put the invention as
11 recited in claim 1 into the public domain. As a result, Kasulke et al.
12 cannot anticipate the invention as recited in claim 1. For at least these
13 reasons, the rejection of claims 1 and 2 is defective and should be
14 withdrawn, and claims 1 and 2 should be allowed.

15 Desai et al. teach (col. 8, lines 52-65; col. 9, line 61 through
16 col. 10, line 30) placement of balls comprising high temperature melting
17 point materials such as Au-plated Cu balls having a reflow temperature
18 of 1,062 °C (col. 10, lines 4-9), on through-plated vias coated with
19 material having a much lower melting point, e.g., SnPb eutectic alloy
20 having a reflow temperature of 183 °C. The balls are then attached by
21 melting the material coating the through-plated vias to solder the balls
22 to the vias. Desai et al. do not teach use of balls of solder for
23 joining substrates as recited in claim 1.

1 Amended claim 3 recites "A method of bonding balls of solder
2 to bond pads on a substrate comprising: placing at least portions of a
3 plurality of balls of solder within a frame and in registered alignment
4 with individual bond pads over a substrate; and while the ball portions
5 are within the frame, exposing the balls to bonding conditions effective
6 to bond the balls with their associated bond pads." Desai et al. do not
7 teach placement of balls of solder, as recited in claim 3.

8 Amended claim 11 recites that "exposing comprises reflowing the
9 balls while the balls are within their individual holes, and further
10 comprising, after reflowing, removing the frame from around the
11 reflowed balls". Desai et al. do not teach reflowing of solder balls, as
12 noted above and as recited in claim 11. Desai et al. further do not
13 teach removing a frame from around reflowed balls, as recited in
14 claim 11.

15 Claim 13 recites "A method of bonding balls of solder to bond
16 pads on a substrate comprising: providing a frame having a plurality of
17 holes sized to receive individual solder balls; delivering individual balls
18 of solder into the holes from over the frame; placing the balls into
19 registered alignment, while the balls are in the holes, with a plurality
20 of individual bond pads over a substrate; and bonding the balls with
21 their individual associated bond pads." Desai et al. do not teach use
22 of balls of solder for joining substrates.
23

1 Claim 27 recites "A method of bonding a ball of solder to a
2 bond pad on a substrate comprising: providing a frame having a hole;
3 providing a ball of solder having an outer surface; retaining the ball of
4 solder within the hole in an ambient processing environment which is
5 generally uniform over the entirety of the ball's outer surface; and while
6 the ball of solder is within the hole, bonding the ball of solder with an
7 associated bond pad on a substrate." Desai et al. do not teach bonding
8 using balls of solder, as noted above and as recited in claim 27.

9 Claim 31 recites "A method of bonding balls of solder to bond
10 pads on a substrate comprising: providing a surface having a plurality
11 of holes therein; providing a plurality of balls of solder over the
12 surface; depositing some of the balls of solder into at least some of the
13 holes; and bonding the balls of solder which were deposited into the
14 holes to individual associated bond pads positioned on a substrate
15 proximate the holes." Desai et al. do not teach bonding using balls of
16 solder, as noted above and as recited in claim 31.

17 For at least these reasons, the rejection of claims 1, 3, 11-13, 27,
18 29 and 31 should be withdrawn, and claims 1, 3, 11-13, 27, 29 and 31
19 should be allowed.

20 The Office Action states (p. 3, item 7), in making the §102(b)
21 rejection, that "Regarding claim 22, Desai further teaches moving the
22 frame by vibration to position balls within the holes and effectuate
23 bonding (discussed at col. 9, lines 50-53)." However, claim 22 is not

1 rejected under 35 U.S.C. § 102(b). Clarification of the rejection is
2 requested.

3 Claims 2, 6, 8, 20, 22-24, 26, 30, 36 and 37 (and 41) all recite
4 "laser bonding" of one or more solder balls. Kasulke et al. teach
5 placing balls of solder one at a time and laser bonding each ball as it
6 is placed.

7 Desai et al. teach away from use of balls of solder. Desai et al.
8 teach that it is undesirable to employ balls of solder (col. 7,
9 lines 29-52), at least in part because some prior art techniques required
10 use of AuSn or Au bonds and because of concerns stemming from
11 formation of CuAu intermetallic compounds.

12 Neither Kasulke et al. nor Desai et al. teach, disclose, suggest or
13 motivate "providing a frame having a plurality of holes; inserting
14 individual solder balls into the holes, the balls being small enough to
15 pass through the holes; placing the frame into proximity with a substrate
16 having bond pads positioned thereon, more than one of the plurality of
17 holes holding an individual solder ball therewithin and in registered
18 alignment with an associated bond pad on the substrate; laser-bonding
19 the solder balls to their individual bond pad; and after the laser
20 bonding, removing the frame from proximity with the substrate" as
21 recited in claim 23.

22 Kasulke et al. teach a method of projecting a single ball through
23 a capillary to a substrate. Desai et al. teach formation of holes in a

1 printed circuit board equipped to retain copper balls, and do not teach
2 removal of the frame after bonding of the balls, as recited in claim 23.

3 Amended claim 41 recites "A method of bonding balls of solder
4 to bond pads on a substrate comprising: providing a surface having a
5 plurality of holes therein; providing more balls of solder than there are
6 holes over the surface; moving the plurality of balls and the surface
7 relative to one another effective to deposit one ball of solder into each
8 hole; removing excess balls of solder from over the surface; and bonding
9 the balls which were deposited into the holes to individual bond pads
10 positioned on a substrate proximate the holes, wherein bonding comprises
11 laser bonding the balls by moving each ball into the path of a laser
12 beam." Kasulke et al. teach a method of projecting a single ball
13 through a capillary to a substrate. Desai et al. teach away from use
14 of balls of solder, as recited in claim 41. Combining the teachings of
15 Kasulke et al. with those of Desai et al. does not and cannot provide
16 the invention as recited in claim 41.

17 Accordingly, combining the teachings of Kasulke et al. with those
18 of Desai et al. does not and cannot provide the invention as recited in
19 any of claims 2, 6, 8, 20, 22-24, 26, 30, 36 and 37.

20 Because combining the teachings of the cited references fail to
21 provide the invention as recited in claims 2, 6, 8, 20, 22-24, 26, 30, 36
22 and 37, the rejection of these claims is defective and should be
23

1 withdrawn, and claims 2, 6, 8, 20, 22-24, 26, 30, 36 and 37 (and 41)
2 should be allowed.

3 Moreover, it is a main intent of Desai et al. to avoid melting of
4 the balls. This main intent is destroyed in attempting to combine the
5 teachings of Kasulke et al. with those of Desai et al. Melting the balls
6 taught by Desai et al. with the laser system taught by Kasulke et al.
7 defeats this main intent of Desai et al. Further, the balls employed by
8 Desai et al. prevent a laser from illuminating the lower melting point
9 material coating the vias.

10 Applicants note the requirements of MPEP §2143.01, entitled
11 "Suggestion or Motivation to Modify the References", stating that
12 "THE PROPOSED MODIFICATION CANNOT RENDER THE
13 PRIOR ART UNSATISFACTORY FOR ITS INTENDED PURPOSE."
14 MPEP §2143.01 further states that "If proposed modification would
15 render the prior art invention being modified unsatisfactory for its
16 intended purpose, then there is no suggestion or motivation to make the
17 proposed modification. *In re Gordon*, 733 F.2d 900, 221 USPQ 1125
18 (Fed. Cir. 1984)."

19 Because the combinations proposed by the Examiner would render
20 the teachings of Desai et al. unsatisfactory for Desai et al.'s intended
21 purpose, the rejection of claims 2, 6, 8, 20, 22-24, 26, 30, 36 and 37
22 is improper and should be withdrawn.
23

1 The rejection fails to meet the standards for a rejection under 35
2 U.S.C. §103(a) as set forth in The Manual of Patent Examination
3 Procedure at §706.02(j), entitled "Contents of a 35 U.S.C. 103
4 Rejection." This MPEP section states that three basic criteria must be
5 met in order to establish a prima facie case of obviousness.

6 The first of these is that there must be some suggestion or
7 motivation, either in the references themselves or in the knowledge
8 generally available to one of ordinary skill in the art to modify the
9 reference or to combine reference teachings. The Office Action fails
10 to show that the subject matter of the claims is suggested or motivated
11 by the teachings of the references, and Applicants have shown that
12 there is no suggestion or motivation to combine the teachings of the
13 references.

14 The second requirement of MPEP §706.02(j) is that there must be
15 a reasonable expectation of success. Laser treatments involve brief
16 pulses of light and heat material immediately adjacent the zone of
17 impingement of the beam. The balls employed by Desai et al. prevent
18 a laser from illuminating the lower melting point material coating the
19 vias. Accordingly, the inoperative combination proposed in the Office
20 Action fails to provide a reasonable expectation of success.

21 The third requirement is that the prior art reference (or
22 references when combined) must teach or suggest all of the claim
23 limitations. Since Kasulke et al. teach one-at-a-time solder ball

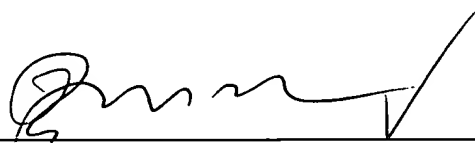
1 placement, and Desai et al. teach away from solder balls, combining
2 their teachings cannot provide the invention as recited in Applicants'
3 claims.

4 In particular, the cited references fail to teach that "exposing
5 comprises laser bonding the balls with their associated bond pads by
6 fixing the position of a laser beam and moving the frame relative to the
7 laser beam from ball-to-ball" as recited in claim 8. Kasulke et al.
8 teach moving the substrate relative to the laser beam, and keeping the
9 ball-placement capillary in a fixed spatial relationship with the laser
10 beam (see, e.g., Fig. 3 and associated text).

11 In view of the foregoing, allowance of claims 1-3, 6, 8, 11-13, 20,
12 22-24, 26, 27, 29-31, 36 and 37 is requested. The Examiner is
13 requested to phone the undersigned in the event that the next Office
14 Action is one other than a Notice of Allowance. The undersigned is
15 available for telephone consultation at any time during normal business
16 hours (Pacific Time Zone).

17
18 Respectfully submitted,

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20 Dated: Mar. 9, 2000

21 By: 
22 Frederick M. Fliegel, Ph.D.
23 Reg. No. 36,138